

PCT

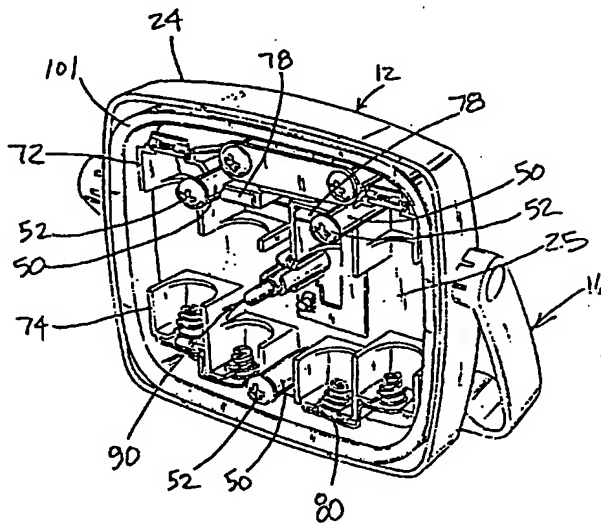
WORLD INTELLECTUAL PROPERTY ORGANIZATION  
International Bureau



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>6</sup> : <b>F21L 15/08</b>	<b>A1</b>	(11) International Publication Number: <b>WO 97/04271</b> (43) International Publication Date: <b>6 February 1997 (06.02.97)</b>
(21) International Application Number: <b>PCT/US96/11888</b> (22) International Filing Date: <b>19 July 1996 (19.07.96)</b> (30) Priority Data: <b>08/503,930</b> <b>19 July 1995 (19.07.95)</b> <b>US</b> (71) Applicant: <b>DIAMONDLIGHT INDUSTRIES, INC. [US/US]:</b> <b>2191-A Airport Loop Drive, Costa Mesa, CA 92626 (US).</b> (72) Inventor: <b>SHEPS, Martin, I.; 16139 Ladera Piedra, Poway, CA 92605 (US).</b> (74) Agents: <b>STETTINA, Kit, M. et al.; Stetina Brunda &amp; Buyan,</b> <b>Suite 401, 24221 Calle de la Louisa, Laguna Hills, CA 92653 (US).</b>		(81) Designated States: <b>CA, JP, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).</b>  <b>Published</b> <i>With international search report.</i>

(54) Title: **PORTABLE FLASHLIGHT**



(57) Abstract

A portable flashlight (10) includes a low-profile housing (12). Disposed within the housing are a special lens (14), a power source, and a light source (90). The light source has a shoulder portion (96), and a lamp portion with a filament (94) a controlled distance from the shoulder. A socket (99) inside the housing a controlled distance from the lens receives the shoulder portion of the light source. The socket receives the light source, electrically connecting the light source to the power source. Control of the focal length provides a collimated beam of light. A handle (16) formed to the housing with a multiple-position detent (30), is operative as a carrying handle or as a support stand. The housing comprises two halves (22, 24) that are releasably attached to each other by a camming mechanism (48). A number of gasket seals (101, 105) are provided to create a substantially water-tight construction.

BEST AVAILABLE COPY

BEST AVAILABLE COPY

*FOR THE PURPOSES OF INFORMATION ONLY*

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AM	Armenia	GB	United Kingdom	MW	Malawi
AT	Austria	GE	Georgia	MX	Mexico
AU	Australia	GN	Guinea	NE	Niger
BB	Barbados	GR	Greece	NL	Netherlands
BE	Belgium	HU	Hungary	NO	Norway
BF	Burkina Faso	IE	Ireland	NZ	New Zealand
BG	Bulgaria	IT	Italy	PL	Poland
BJ	Benin	JP	Japan	PT	Portugal
BR	Brazil	KE	Kenya	RO	Romania
BY	Belarus	KG	Kyrgyzstan	RU	Russian Federation
CA	Canada	KP	Democratic People's Republic of Korea	SD	Sudan
CF	Central African Republic			SE	Sweden
CG	Congo	KR	Republic of Korea	SG	Singapore
CH	Switzerland	KZ	Kazakhstan	SI	Slovenia
CI	Côte d'Ivoire	LI	Liechtenstein	SK	Slovakia
CM	Cameroon	LK	Sri Lanka	SN	Senegal
CN	China	LR	Liberia	SZ	Swaziland
CS	Czechoslovakia	LT	Lithuania	TD	Chad
CZ	Czech Republic	LU	Luxembourg	TG	Togo
DE	Germany	LV	Latvia	TJ	Tajikistan
DK	Denmark	MC	Monaco	TT	Trinidad and Tobago
EE	Estonia	MD	Republic of Moldova	UA	Ukraine
ES	Spain	MG	Madagascar	UG	Uganda
FI	Finland	ML	Mali	US	United States of America
FR	France	MN	Mongolia	UZ	Uzbekistan
GA	Gabon	MR	Mauritania	VN	Viet Nam

-1-

**PORTABLE FLASHLIGHT****Field of the Invention**

The present invention relates generally to a  
5 portable flashlight, and more particularly to a low-  
profile flashlight that also is waterproof and easily  
disassembled.

**Background of the Invention**

10 Various portable lanterns and flashlights have been  
previously known. These devices are frequently used in  
outdoor activities, such as camping, hiking, or the like.  
Also, these devices are frequently used in emergency  
conditions (e.g., earthquakes, windstorms, floods, etc.)  
15 when electric power provided by utilities is lost. In  
addition, portable flashlights are used by security  
personnel at night (e.g., policemen, watch guards, etc.)  
to provide a light source for safety. Portable  
flashlights used outdoors, either for leisure activities  
20 or in emergency or for security, are desirably able to  
survive being immersed in or exposed to water.

The prior art has generally included heavy-duty  
flashlights and electric lanterns which were large and  
heavy, mainly due to the large battery or many batteries  
25 contained in the device. The prior art flashlights often  
produce beams which are not well collimated. Also, some  
prior art portable flashlights are not sufficiently  
water-tight to avoid damage if dropped in a stream or  
exposed to heavy rainfall. Further, at least some prior  
30 art flashlights have been difficult or cumbersome to  
disassemble and reassemble, usually requiring the removal  
of loose batteries and the screwing of threaded  
attachment members subject to wear.

Though the prior art has made some progress in  
35 providing more compact, lightweight, and all-around  
better functioning flashlights, the above-mentioned

-2-

deficiencies of the prior art have yet to be fully addressed and remedied.

#### Summary of the Invention

5       The present invention generally comprise a portable flashlight which includes a low-profile housing and, disposed within the housing, a lens, power source, and light source. The light source has a shoulder portion and a lamp portion. The lamp portion incorporates an  
10 illumination filament which is located a controlled distance from the shoulder portion. A socket is disposed inside the housing a controlled distance from the lens, and is sized to receive the shoulder portion of the light source. When the shoulder portion of the light source is  
15 received within the socket, an electrical connection is completed between the filament and the power source. Also, the filament is thereby located at a controlled distance from the lens. This control of the focal length provides a collimated beam of light from a low-profile  
20 housing.

The lens of the flashlight device of the present invention may comprise any suitable type of lens, including the lens described in United States Patent No. 4,337,759 previously issued to Applicant.

25       In a preferred embodiment, the portable flashlight of the present invention may further comprise a handle formed on or connected to the housing with a multi-position detent mechanism which enables the handle to be rotated and converted into a stand to support the  
30 flashlight. The flashlight may further include a clip attached to the housing, to support the flashlight for attachment to an individual's clothing.

Also in a preferred embodiment of the invention, the housing may be formed in two halves or portions which are  
35 releasably attached to each other. One half or portion of the housing has a plurality of protruding pins, and the other half or portion of the housing has a plurality

-3-

of camming slots located and sized to slidably receive the pins. Movement of one half of the housing relative to the other half serves to latch or unlatch the housing.

In yet another embodiment of the present invention, the portable flashlight may further include a number of seals disposed between the halves of the housing, and between the lens and the housing. This embodiment of the flashlight may further includes an on/off switch disposed within the housing, and a seal formed to the switch and the housing. These seals provide, in combination with one another, a substantially water-tight construction.

The portable flashlight of the present invention utilizes a low-profile housing and provides a well collimated beam of light. A preferred embodiment of the present invention further provides a carrying handle that may be indexed into place and locked to function as a stand against a flat surface. The housing is easily disassembled and reassembled by rotating one-half relative to the other half, utilizing a simple camming mechanism.

These, as well as other advantages of the present invention will become more apparent from the following description and drawings. It is understood that changes in the specific structure shown and described may be made within the scope of the claims without departing from the spirit of the invention.

#### Brief Description of the Drawings

Figure 1 is a perspective view of a portable flashlight of the present invention, with the handle in a carrying position;

Figure 2 is a reverse angle perspective view of the portable flashlight of Figure 1, with the handle serving as a stand;

Figure 3 is a perspective view of the flashlight of Figure 1 in a state of partial disassembly;

-4-

Figure 4 is a perspective view of the first half of the housing of the flashlight of Figure 1, showing the presence of slotted cam grooves therein;

Figure 5 is a reverse angle perspective view of the first half of the housing shown in Figure 4;

Figure 5a is a detailed view of a portion of the housing of Figure 5 showing the ramped cam mechanism thereof;

Figure 6 is a perspective view of the second half of the housing of the flashlight of Figure 1;

Figure 7 is an exploded perspective view of the electrical connections of the flashlight;

Figure 8 is an exploded perspective view of the on/off switch of the flashlight;

Figure 9 is a cross-sectional view of a portion of the flashlight of Figure 1 showing the on/off switch and the light source of the flashlight; and

Figure 10 is a cross-sectional view of a portion of the flashlight of Figure 1 showing the seal which is disposed between the two halves of the housing.

#### Detailed Description of the Preferred Embodiment

The detailed discussion set forth below in connection with the appended drawings is intended as a description of the presently preferred embodiments of the invention, and is not intended to represent the only forms in which the present invention may be constructed or utilized. The description sets forth the functions and sequences of steps for constructing and operating the invention in connection with the illustrated embodiments. It is to be understood, however, that the same or equivalent functions and sequences may be accomplished by different embodiments that are also intended to be encompassed within the spirit and scope of the invention.

The portable flashlight 10 of the present invention is illustrated in Figures 1-10 which depict a presently preferred embodiment of the invention. Referring now to

BEST AVAILABLE COPY

-5-

Figures 1-3, the exterior of the portable flashlight 10 is comprised of a generally square-shaped housing 12 of a limited depth, a special lens 14 of a substantial width disposed within the housing 12 and a handle 16 attached to the housing 12. The portable flashlight 10 further includes a flexible clip 18 attached to the housing 12, and an on/off switch 20 disposed within the housing 12. The housing 12 has a first half 22 and a second half 24 which are releasably connected to each other. The structural components of the portable flashlight 10 are preferably fabricated of conventional molded plastic, offering the advantages of low weight and low cost. The lens 14 is preferably constructed in accordance with Applicant's United States Letters Patent No. 4,337,759, entitled RADIANT ENERGY CONCENTRATION BY OPTICAL TOTAL INTERNAL REFLECTION, the disclosure of which is expressly incorporated herein by reference.

Next, details of the construction of the exterior of the portable flashlight 10 may be more fully described. Referring to Figure 1, the handle 16 includes a grip 26 to provide an increased surface area for holding the handle 16 while carrying the portable flashlight 10. The attachment of the handle 16 is formed to the housing 12 with a multi-position detent having six teeth 30. An axial pin 34 is formed in each side of the second half 24 of the housing 12 (see Figure 7). Each axial pin 34 has plural grooves 32 operative to engage the teeth 30 within the handle 16. Referring to Figure 2, a recessed area 36 is formed in the rear surface 38 of the second half 24 of the housing 12. The on/off switch 20 is mounted to extend within the recessed area 36, so as to minimize protrusion beyond the rear surface 38 of the housing 12.

Now referring to Figures 4-6, the configuration of the interior of the housing 12 of the preferred embodiment of the portable flashlight 10 may be described. The forward side 21 of the first half 22 of the housing 12 is shown in Figure 4, with the lens 14

BEST AVAILABLE COPY

-6-

removed. The plural mounting holes 13 for the lens 14 are evident, as well as the recessed surface 15. Figure 5a shows how the lens 14 is held in the first half 22 of the housing 12. Plural pins 60 are formed on the lens 14 and pass through the mounting holes 13 to be secured by the retainers 62. Figure 5 shows the aft side 23 of the first half 22 of the housing 12, having a recessed surface 17 and a hold-down rib 19. A clearance opening 42 is formed in the first half 22 of the housing 12 for a lightbulb 90 (see Figure 6). Surrounding the opening 42 is a spherical dish 46 with highly reflective material formed thereon.

Also referring to Figures 4-6, the ramped camming groove mechanism connecting the two halves 22 and 24 of the housing 12 may be described. The first half 22 has three camming slots 48 which are arranged in a circular pattern about the opening 42, the slots 48 following a circular centerline c. Three cylindrical bosses 50 are formed in the second half 24 of the housing 12 corresponding to the slot 48 locations. Each cylindrical boss 50 has a bore formed therein to receive a retaining screw 52. Each of the slots 48 on the aft side 23 has an entry opening 54 sized to allow passage of the head of the retaining screw 52 therethrough. Within each of the slots 48 is a ramped groove 56 that the head of the retaining screw 52 rides upon.

Figures 6 and 7 illustrate the electrical components inside the housing 12 of the preferred embodiment of the portable flashlight 10 of the present invention. Four sets of upper and lower support ribs 72 and 74 are formed to the inside surface 25 of the second half 24 of the housing 12, to support four "A-A" sized batteries (not shown). The upper and lower support ribs 72 and 74 each have contact slots 76 to hold spring barb contacts 78 (inboard) and 79 (outboard) and the spring contacts 80. The contacts 78, 79, and 80 are electrically connected



-7-

with the batteries and switch 20 to form an electrical circuit..

Now referring to Figures 7-9, the parts of the on/off switch 20 may be described. The electric switch 80 is a conventional single pole, double throw switch. A pair of wires 82 connect the switch 80 to the outboard barb contacts 79. A strap 84 and a pair of screws 85 hold the electric switch 80 in place against the inside surface 25 of the housing 12.

Referring to Figures 7 and 9, the lightbulb 90 of the preferred embodiment of the portable flashlight 10 may be described. The lightbulb 90 has a lamp portion 92 having a substantially horizontal filament 94. The lightbulb 90 further has a shoulder portion 96 having a substantially flat end 98. Protruding from the flat end 98 are a pair of wires 95 which electrically connect to the inboard barb contacts 78. The shoulder portion 96 of the lightbulb 90 is held in place by a socket 99 formed into the inside surface 25 of the housing 12. The socket 99 has a substantially flat end 97 against which bears the flat end 98 of the shoulder portion 96. The net result is to locate the filament 94 at the focal point on the lens 14. When the lightbulb 90 is properly engaged in the socket 99, the lightbulb 90 portion 92 thereof is centrally positioned at the focal point of the lamp dish 46.

Now referring to Figures 9 and 10, the water-tight construction of the preferred embodiment of the portable flashlight 10 of the present invention may be described. The main seal 101 is generally square-shaped and disposed between the first half 22 and the second half 24 of the housing 12. A lens seal 103 is annular shaped and disposed between the lens and the first half 22 of the housing 12. A switch seal 105 is hat shaped and disposed around the electric switch 80 and between the second half 24 of the housing 12. The seals 101, 103, and 105 are

BEST AVAILABLE COPY

-8-

fabricated of a pliable rubber-like material as commonly used for conventional gasket seals.

Now the operation of the preferred embodiment of the portable flashlight 10 of the present invention may be described. The first step of using the portable flashlight 10 may be the installation of four "A-A" sized batteries (not shown). To install the batteries, the two halves 22 and 24 of the housing 12 are separated to provide access. A simple 45-degree turn of the first half 22 relative to the second half 24 enable the housing 12 to be opened. The cylindrical bosses 50 ride through the slots 48 with the retaining screws 52 riding along the ramped grooves 56, causing a small gap to develop between the two halves 22 and 24 of the housing 12. This takes the pressure off the main seal 101, and the seal 101 moves to a relaxed position (see Figure 10). When the retaining screws 52 reach the entry opening 54 of the slots 48, the two halves of the housing 12 may be separated by pulling the cylindrical bosses 50 and retaining screws 52 through the entry openings 54.

Once the housing 12 is opened, four "A-A" sized batteries may be installed in the second half 24 of the housing 12 in the forward and aft support cradles 72 and 76. It should be noted that the spring contacts 80 are uniquely adapted to facilitate both the positive as well as the negative terminals of the batteries. Then the portable flashlight 10 may be reassembled by reversing the steps involved in disassembly. The reassembly of the housing 12 is begun by aligning the two halves 22 and 24 at indicating marks 40 (Figure 3). Rotating the first half 22 relative to the second half 24 on the ramped grooves 56 inside the camming slots 48 causes the first half 22 to bear against the main seal 101. The ribs 19 in the aft side 23 progressively wipe the lip of seal 101, positioning the first half 22 and preventing shearing of the seal 101 during rotational movement. The

BEST AVAILABLE COPY

-9-

seal 101 is deformed (Figure 9) closing off the housing 12 interior to water.

Upon pressing the on/off switch 20 one time, the single pole, double throw switch 80 is turned on, thereby opening the circuit between the pair of wires 82, which allows electricity to flow from the batteries through the contacts 78, 79, and 80 to the lightbulb 90. Pressing the on/off switch 20 again opens the circuit and cuts off the power supply from the lightbulb 90.

10 The handle 16 may be rotated into a carrying position, as shown in Figure 1, or into a position to function as a stand for the portable flashlight 10, as shown in Figure 2. Alternatively, the portable flashlight 10 may be supported on the belt or shirt  
15 pocket of the user through use of the clip 18.

It is understood that the portable flashlight 10 described herein and shown in the drawings represents only a presently preferred embodiment of the invention. Indeed, various modifications and additions may be made  
20 to the embodiment without departing from the spirit and scope of the invention. These modifications and additions may be obvious to those skilled in the art and may be implemented to adapt the present invention for use in a variety of different applications.

-10-

## WHAT IS CLAIMED IS:

1. A portable flashlight, comprising:
  - a housing;
  - a lens disposed proximate said housing;
  - 5 a power source disposed proximate said housing;
  - a light source having a shoulder portion and an opposing lamp portion, said lamp portion comprising a filament which is located at a controlled distance from the shoulder portion;
  - 10 a socket disposed within said housing a controlled distance from said lens, said socket sized to receive the shoulder portion of the light source; and
  - the shoulder portion of the light source
  - 15 disposed within the socket, electrically connecting said power source to the light source;
  - wherein the resultant position of the light source filament relative to the lens defines a focal position which results in a collimated beam of light, and said housing is configured as a low-
  - 20 profile housing, the depth of which is substantially less than the width of the lens.
2. The portable flashlight of Claim 1, wherein:
  - the shoulder portion has a substantially flat
  - 25 end, that bears against a substantially flat inside end of the socket.
3. The portable flashlight of Claim 1, wherein:
  - the filament of the lamp portion of the light
  - source is substantially parallel to the shoulder
  - 30 end.
4. The portable flashlight of Claim 1, further comprising:
  - a reflector formed on the housing, near said
  - socket.
- 35 5. The portable flashlight of Claim 1, further comprising:

BEST AVAILABLE COPY

-11-

a handle member attached to said housing, and adapted to index relative said housing.

6. The portable flashlight of Claim 5, wherein:  
the attachment of said handle member formed to  
5 the housing is formed with a multi-position detent;  
whereby said handle may be operative as a stand  
to support the flashlight.

7. The portable flashlight of Claim 1, further  
comprising:

10 a clip member attached to said housing;  
whereby said clip may attach to an individual's  
clothing to support the flashlight.

8. A portable flashlight comprising:  
a housing having first and second halves which  
15 are releasably attached to each other, and a first  
seal disposed between said first and second halves;  
a lens disposed within said housing, and a  
second seal disposed between said lens and the  
housing;

20 a power source disposed within said housing;  
a light source disposed within said housing;  
and

a switch disposed within said housing, said  
switch electrically connecting said power source to  
25 said light source, and the switch having a third  
seal formed to the switch and the housing;

whereby said seals provide the flashlight with  
a substantially water-tight construction.

9. The portable flashlight of Claim 8, wherein the  
30 housing has a recessed area and the switch is disposed in  
said recessed area, the switch below the surface of the  
housing adjacent the recessed area.

10. The portable flashlight of Claim 8, wherein the  
switch is a single pole double throw switch.

35 11. A portable flashlight, comprising:  
a housing having first and second halves which  
are releasably attached to each other;

-12-

a lens disposed within said housing;  
a light source disposed within said housing;  
the housing second half having a plurality of  
cylindrical bosses; and

5       the housing first half having a plurality of  
camming slots located and sized to slidably receive  
said bosses, said slots each have a clearance hole  
to allow removal of the bosses from the slots;

10       whereby movement of the first half of the  
housing relative to the second half is operative to  
latch or unlatch the housing.

12. The portable flashlight of Claim 11, wherein:  
the slots are substantially along a circular  
centerline about the center of the housing;

15       whereby rotation of the first half is operative  
to latch or unlatch the housing.

13. The portable flashlight of Claim 11, further  
comprising:

20       a first seal between said first and second  
halves of the housing; and

the camming slots have ramped grooves;  
whereby rotation of the first half in the  
latching direction is operative to deform the first  
seal making the housing substantially water-tight.

25       14. A portable flashlight comprising:

a housing having first and second halves which  
are releasably attached to each other;

a lens disposed within said housing;

30       a plurality of conventional batteries disposed  
within said housing, each battery having a  
protruding positive electrode at one end and a  
recessed negative electrode at an opposing end;

a light source disposed within said housing;

and

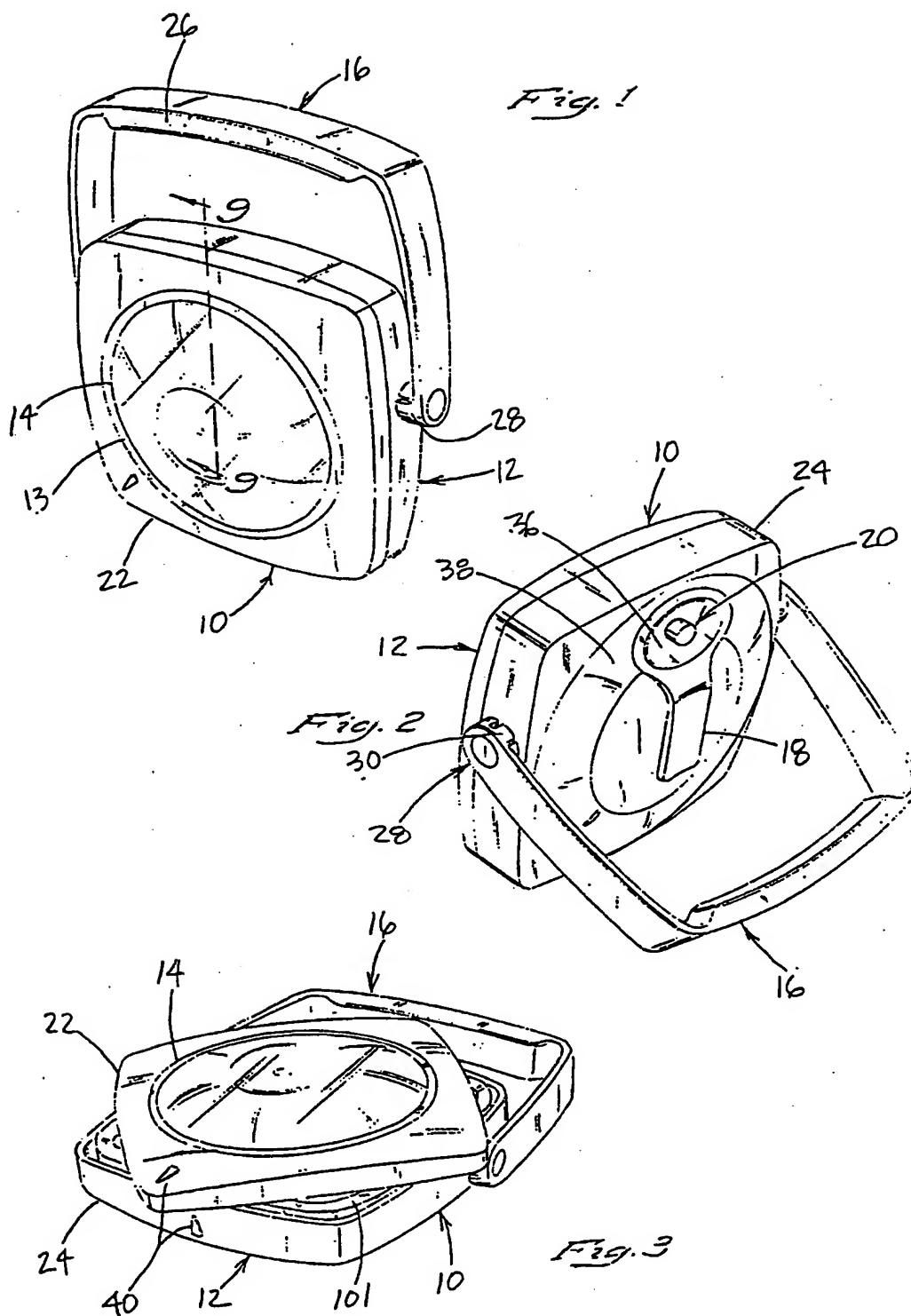
35       a plurality of spring contacts electrically  
connected to said protruding positive electrode and  
to said light source.

-13-

15. The portable flashlight of Claim 14, wherein the housing has one or more ribs sized to maintain said batteries in electrical connection with said contact.

BEST AVAILABLE COPY

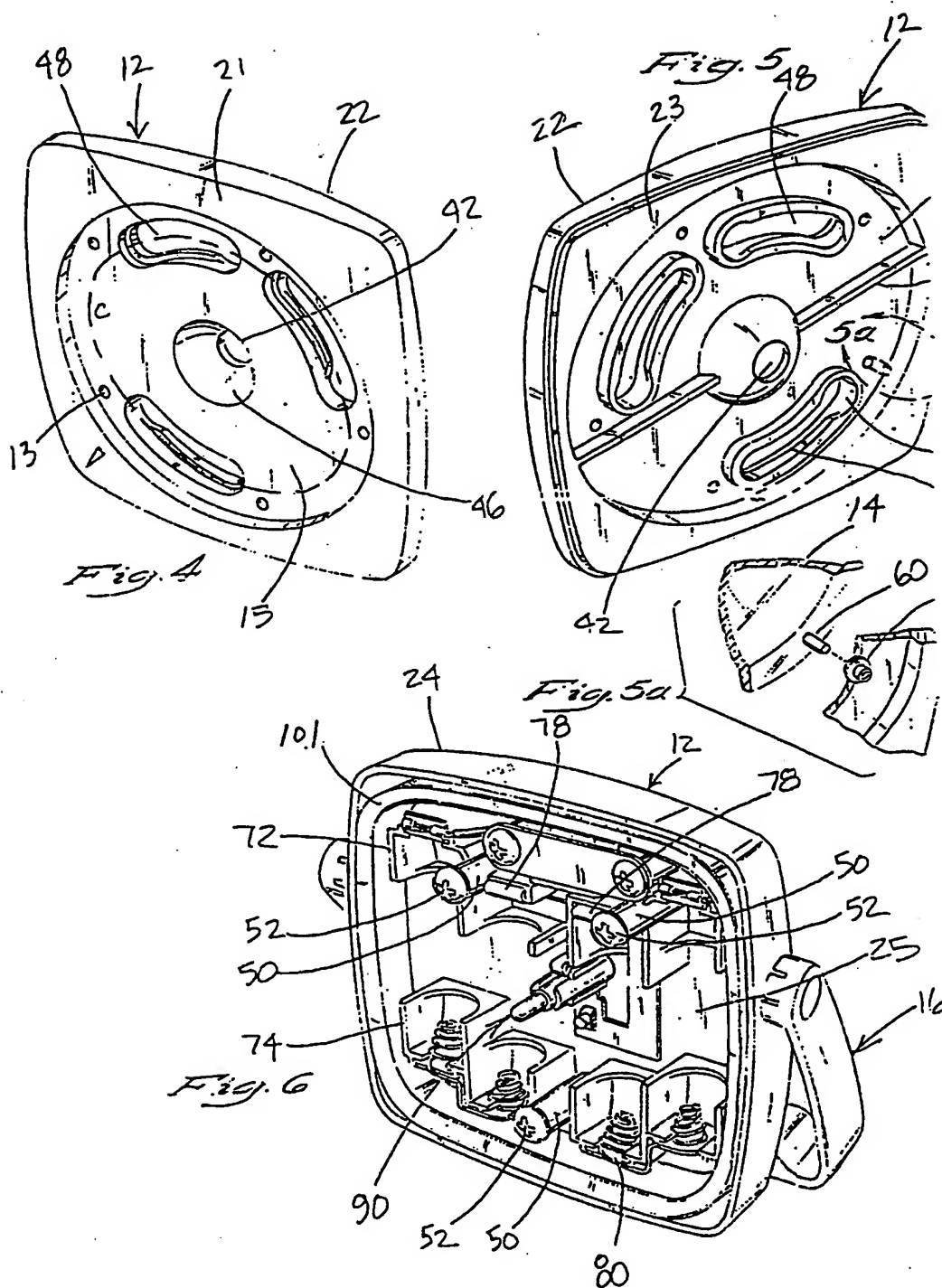
1/4

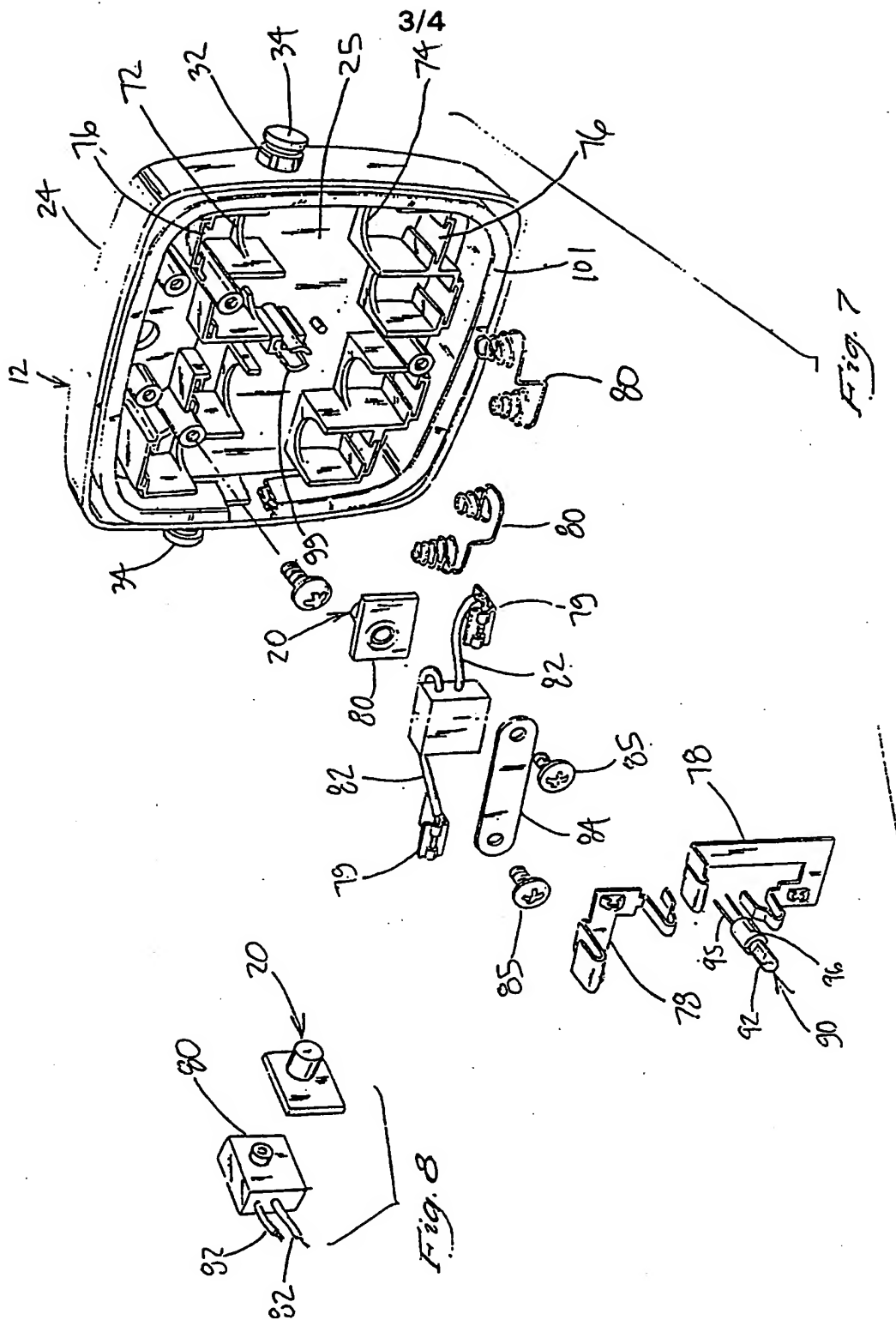


BEST AVAILABLE COPY



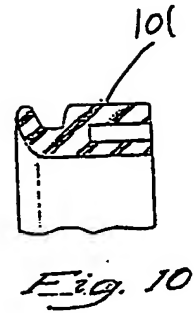
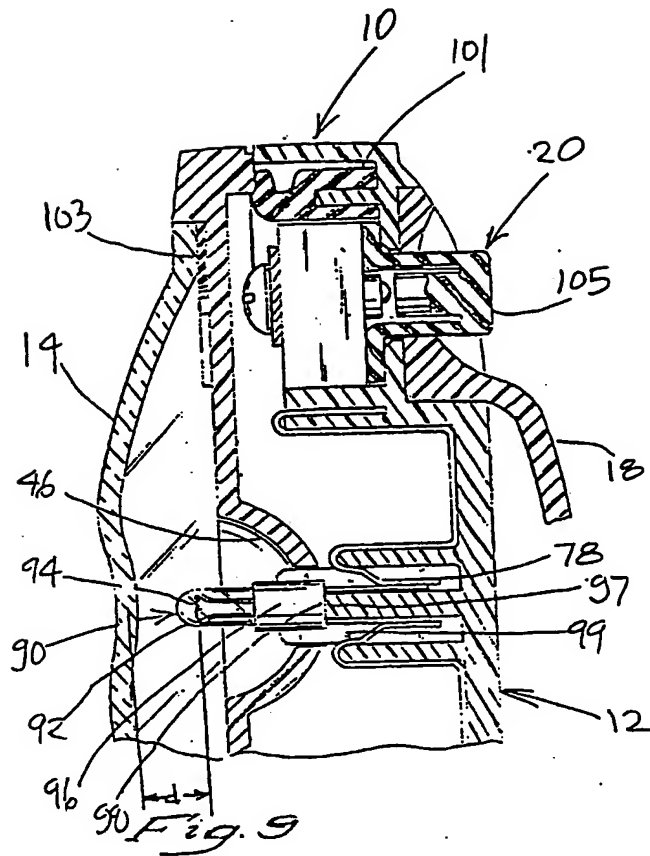
2/4





BEST AVAILABLE COPY

4/4



BEST AVAILABLE COPY

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US96/11888

<b>A. CLASSIFICATION OF SUBJECT MATTER</b> IPC(6) :F21L 15/08 US CL :362/157, 158, 196, 190, 267, 396, 399 According to International Patent Classification (IPC) or to both national classification and IPC																										
<b>B. FIELDS SEARCHED</b> Minimum documentation searched (classification system followed by classification symbols) U.S. : 362/157, 158, 196, 190, 267, 396, 399  Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)																										
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>																										
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.																								
X, P ---- Y, P	US, A, 5,469,345 (PETTERSEN ET AL.) 21 November 1995, see columns 3 and 4.	1, 4, 5, 8, 9, 11, 14, 15 ---- 2, 3, 6, 7, 10, 12																								
Y	US, A, 1,327,017 (BOLTSHAUSER) 06 January 1920, see figure 1.	2, 12																								
Y	US, A, 4,398,237 (DOYEL) 09 August 1983, see figure 2.	3																								
Y	US, A, 3,813,004 (ANDREAGGI) 28 May 1974, see figure 6.	6																								
Y	US, A, 4,451,871 (KIRKLEY ET AL.) 29 May 1984, see figure 3.	7																								
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.																										
<table border="0"><tr><td colspan="2">* Special categories of cited documents:</td><td>*T</td><td>later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</td></tr><tr><td>*A</td><td>document defining the general state of the art which is not considered to be of particular relevance</td><td>*X</td><td>document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</td></tr><tr><td>*E</td><td>earlier document published on or after the international filing date</td><td>*Y</td><td>document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</td></tr><tr><td>*L</td><td>document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</td><td>*G</td><td>document member of the same patent family</td></tr><tr><td>*O</td><td>document referring to an oral disclosure, use, exhibition or other means</td><td></td><td></td></tr><tr><td>*P</td><td>document published prior to the international filing date but later than the priority date claimed</td><td></td><td></td></tr></table>			* Special categories of cited documents:		*T	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention	*A	document defining the general state of the art which is not considered to be of particular relevance	*X	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone	*E	earlier document published on or after the international filing date	*Y	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art	*L	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	*G	document member of the same patent family	*O	document referring to an oral disclosure, use, exhibition or other means			*P	document published prior to the international filing date but later than the priority date claimed		
* Special categories of cited documents:		*T	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention																							
*A	document defining the general state of the art which is not considered to be of particular relevance	*X	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone																							
*E	earlier document published on or after the international filing date	*Y	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art																							
*L	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	*G	document member of the same patent family																							
*O	document referring to an oral disclosure, use, exhibition or other means																									
*P	document published prior to the international filing date but later than the priority date claimed																									
Date of the actual completion of the international search 05 SEPTEMBER 1996		Date of mailing of the international search report 04 OCT 1996																								
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230		Authorized officer SARA RAAB <i>Stacia Sinuit for</i> Telephone No. (703) 308-0861																								

Form PCT/ISA/210 (second sheet)(July 1992)\*

BEST AVAILABLE COPY

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US96/11888

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, 4,951,183 (WANG) 21 August 1990, see figure 2.	10
BEST AVAILABLE COPY		